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5G edge as an operations transformation platform for health care providers

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Abstract

Data gathering, sharing, analytics, and insights are playing an increasingly important role for the health care industry. These activities can be critical to providers as they strive to manage their operations, deliver leading patient experiences, and discover and deliver breakthrough treatments efficiently and effectively. Effectively managing data flows, compute, and storage typically requires advanced networks with leading technologies, such as 5G and edge computing.

These emerging technologies often serve as the backbone for high-bandwidth, low-latency, reliable connectivity that health care providers need to offer convenient, personalized, on-demand health experiences for patients while streamlining operations for clinicians and administrators. 5G and edge computing can provide a versatile and reusable platform to layer multiple applications as needed and can serve as a force multiplier for innovation when thoughtfully paired with other emerging technologies (e.g., advanced analytics, automation).

After establishing a reliable, secure, high-speed network, health care systems can layer on information sensing and sharing capabilities (sensors and communication platforms) to capture valuable data points and make sure that associated insights are available to the right resources in the moment. Providers can then add advanced analytics to the "stack" to automate routine decision-making— freeing up clinical staff to practice at the top of their license and provide a human touch to patients during their medical interactions. Finally, health care systems can invest in capabilities outside their facility walls and next-generation therapeutics to continue pushing the boundaries on where, when, and how health care is delivered and to take advantage of scientific breakthroughs that address specific conditions.

Introduction

The life sciences and health care industry features an ever-changing landscape with new discoveries and cutting-edge technology bringing constant innovation. With the emergence of the COVID-19 pandemic, this industry has seen more evolution in the past three years than in the previous decade. Health care is moving away from traditional facility-based settings toward remote diagnosis and care. New, nontraditional players are changing the face of care delivery and how the population at large approaches health and well-being. For example, multiple major tech companies have recently made investments or acquisitions into the health care space,[1] including Amazon's July 2022 acquisition, which expanded its industry capabilities into the primary care space. In addition to incursion by established players, the digital health space is primed for disruption by early-stage companies. In 2021 alone, more than $29 billion was raised by US-based digital health startups, nearly doubling the 2020 investment for the same category of startups.[2]

As patients are increasingly empowered to take charge of their own health, they are generating vast amounts of data through various devices they use. This data can unlock the potential for insights and a 360-degree view of the patient, allowing providers to better diagnose and treat conditions, backed by evidence-based methods. Data is becoming increasingly FAIR[3] (findable, accessible, interoperable, and reusable), allowing greater predictability of what the future holds for patients and their health. Real-world evidence and analysis have helped shape a world where predictive modeling can forecast outcomes and alter the course of disease. The regulatory space is rapidly evolving to fit into this paradigm and accelerated processes and regulations that allow newer, faster, and better technology to come to market into the hands of the people who benefit from it, all without compromising on safety and efficacy. While these driving forces represent an exciting future for providers and patients, tomorrow's landscape of connected health also presents new challenges for industry stakeholders to adapt to.
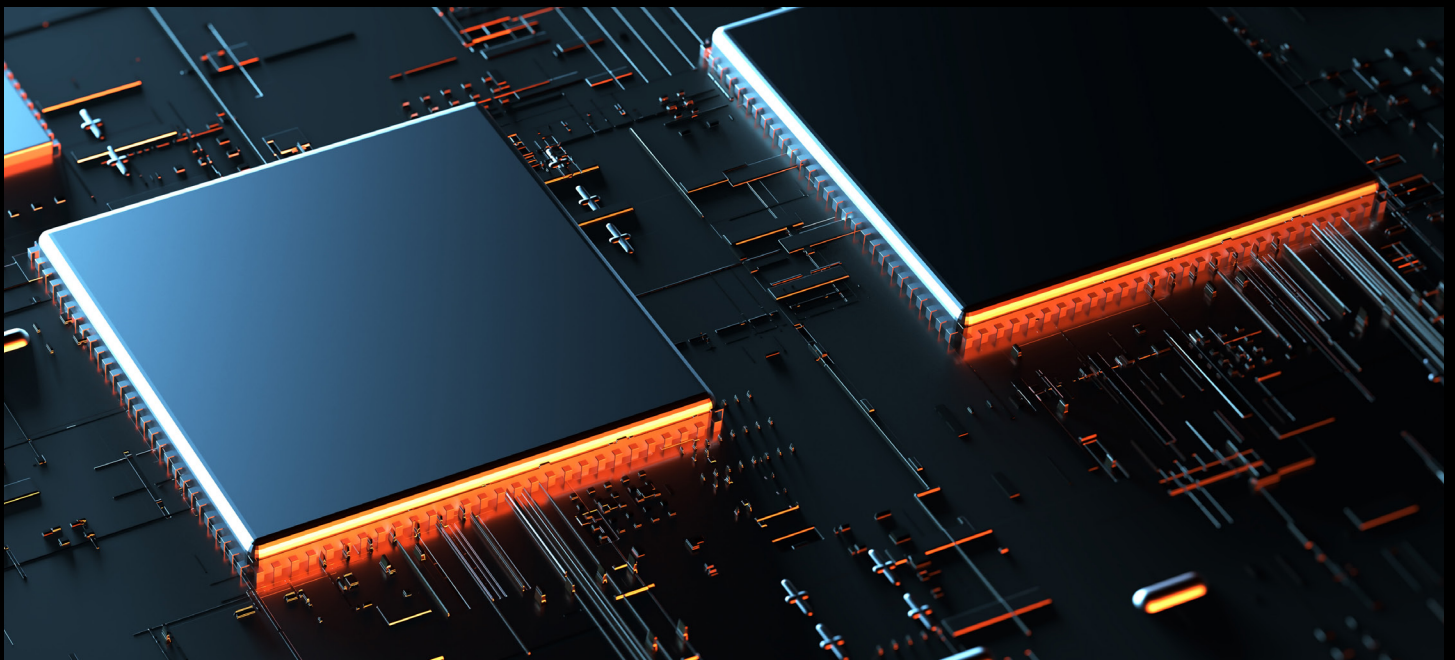
The power of 5G

Foundational shifts in the health care industry are presenting novel challenges for providers. For example, as wireless technologies become an increasingly inextricable part of provider infrastructure (similar to electricity or running water), health care IT professionals should balance evaluating and deploying new generations of these technologies with ensuring patient safety and the stability of overall operations. In addition, provider systems now integrate with partners, vendors, and patients, increasing complexity as well as the security attack surface. As health care IT professionals juggle a dynamic priority list, choosing and implementing the right connectivity for the enterprise will likely become an increasingly critical decision with far-reaching impacts for future technology investments.

As health data rapidly multiplies, today's hospitals should develop a strategy to manage large amounts of patient data spread across multiple platforms that may not be interoperable. On average, health systems (including affiliated providers) use 18 different electronic medical record (EMR) vendors.[4] 5G enables data sharing by supporting exchanges of large files, such as high-definition medical images or large data sets used by researchers, or other applications that require high bandwidth. Additionally, as data outside of formal patient EMRs begins to be recognized and leveraged, the endpoint density that 5G can absorb offers a conduit for that data to flow from patient devices (e.g., wearables, smart appliances) to providers. For example, as connected home devices, such as smart refrigerators, become more common, certain data from these consumer appliances could be leveraged by dieticians to advise patients on their eating habits without requiring them to keep a food journal.

As personalization and on-demand become table stakes, consumers have come to expect the same experiences when managing their health and well-being. 5G can help empower patients to engage with their health data anytime, anywhere, and sometimes using devices that they already own. 5G supports convenience for patients by enabling many parts of the care journey to shift to a home-based setting. For example, a surgical patient who has a multi-day recovery period could be sent home earlier while still receiving inpatient-level care through a combination of remote monitoring, virtual visits, and other digitally enabled care management tools. Additionally, as consumers become more active participants and owners of their health, many have good intentions of lifestyle changes but don't necessarily have the tools to implement them in their day-to-day lives. 5G and edge can support patients in making the right decisions for their health by enabling the delivery of personalized nudges and other interventions in real time.

Finally, 5G offers distinctive advantages that can be critical for certain next-gen hospital applications. As providers transition to innovating care outside of their four walls, as in the case of a remotely monitored chronic patient, 5G can offer the low latency, high reliability, and mobility necessitated by these high-stakes applications. Similarly, a 5G network can allow enterprises to take full advantage of their investments into other emerging technologies. For example, surgical applications that continuously scan a patient's internal anatomy and overlay the image on top of a surgical site (effectively giving the surgeon "X-ray vision") cannot deliver an optimal experience without the low latency and ultra-high bandwidth offered by 5G and edge computing. Investments in advanced connectivity will also likely challenge providers to innovate across their operations with novel applications that leverage the distinctive characteristics of these technologies.

> "There's a lot of considerations when you move the edge around. The band has to be flexible enough and intelligent enough to be capable of delivering the best experience possible based on the scenario. For example, we can have an application running in a data center one day and some component of that app delivered down to an edge compute scenario the day after that."
>
> —**Kelly Larkin,**
>   Associate Vice President,
>   WAN Services Network Reliability Engineering,
>   Providence St. Joseph Health

Stackable use case framework

5G and edge computing together can enable transformation for health care providers by facilitating convenient and customized user experiences while ensuring safety and security of the data that is transmitted via these networks. Deloitte's February 2021 article "5G edge as an operations transformation platform" introduced the concept of "stackable use cases," which focuses on platforms that can be leveraged across multiple applications by layering new, reusable technologies without having to build additional, specialized platforms. Modular additions to existing infrastructure can provide new, discreet technical capabilities that can be leveraged across many use cases and improve the overall return on investment.

Example hospital use case 'stack'

As 5G and edge computing increasingly become part of the solution set for hospitals and other medical facilities, it will be important for health care organizations to strategically develop implementation road maps for infrastructure investments. This methodical approach can benefit enterprises by offering flexible infrastructure that can easily be adapted to new applications.

Base scenario: Establishing the 5G edge-enabling platform
In our example, we will follow a large hospital system's digital transformation using a 5G and edge platform. Due to the high-stakes nature of hospital operations, leaders at our imagined health care system determine that they will build a private 5G network in order to maximize control over network security and performance. While this will initially limit the hospital's use of 5G to on-campus applications, it will provide wireless mobility incremental to what is available through Wi-Fi.

"End-to-end solutions which leverage 5G are dependent on the ability to pull local instances out of a hospital via edge computing. Once these capabilities are mature enough, I can invest in software-defined WAN that can prioritize traffic and create a seamless experience for users and application owners. The real results will be for care delivery staff, who can now get their data real time, as if they're physically plugged right into the asset."

—Mike King,
Group Vice President,
Network Services,
Providence St. Joseph Health

First stacked use case:
Information sensing and sharing

In conjunction with construction of its private 5G network, our hospital outfits facilities and equipment with wireless sensors. 5G's capacity to connect to many devices at once (up to 1 million connections per square kilometer) allows our hospital to connect vast amounts of devices without needing to worry about how to manage additional cables in its physical infrastructure. This means that everything from gurneys to patient bedside devices to staff tablets can communicate their status and location to the network in real time. To manage this flood of new data, our hospital also invests in robust communication platforms to make sure that the right audience has the right information at the right time.

Our hospital can now immediately be alerted when an operating room or other shared resource opens up to maximize resource utilization or receive early alerts of performance degradation within a key piece of medical equipment so that preventive maintenance can be scheduled. Patient experience can also improve since wait times or the status of tests, labs, imaging, and procedures can now be shared in real time to help manage expectations. Furthermore, these new capabilities will become vital in scenarios requiring an immediate, multi-member care team response, such as a STEMI heart attack event. The data provided from our hospital's wealth of connected sensors will accelerate the time in which the best facility and clinician resources can be identified, notified, assembled, and brought up to speed to begin operating on the patient.

"One of the first business improvements that we expect to see after a 5G implementation is day-to-day hospital operations. This could include IoT-connected tracking of medications, more robust temperature controls, or equipment tracking. We also expect to see a reduction in variation among hospitals as data-driven decision-making becomes much more standardized."

—**Mike King,**
Group Vice President,
Network Services,
Providence St. Joseph Health

Second stacked use case:
Advanced analytics

The tsunami of new data that is now available from all the connected sensors implemented within the first stack will quickly become overwhelming to hospital staff. While strong data management systems will help alleviate some of this, advanced analytics will greatly help our hospital home in on actionable insights. Analytics techniques such as artificial intelligence (AI) or machine learning (ML) will also enable automation of day-to-day decision-making, freeing up our hospital's resources to focus on higher-complexity tasks.

Now that our hospital has up-to-the-minute status and availability data for all major resources, it is able to deploy advanced analytics against flow and scheduling tasks. This could include maximizing resource utilization based on historical procedure times or recommending the best sequence of activities to reduce wait time for a complex patient. Advanced analytics will also help our hospital manage its inventory and supply chain, predicting usage of high-demand products and preventing stock-outs.

Advanced analytics capabilities can also improve clinical decision-making and the quality of care that patients receive. For example, with its new analytics investments, our hospital could now offer personalized diagnosis and treatment, in which AI-enabled diagnostic insights and care recommendations help clinicians make faster and more accurate diagnoses. These clinical decision support tools would also have the benefit of being able to leverage larger national or regional data to identify patterns and similarities, versus relying only on the patient EMR.

"HCA Healthcare needs to have the ability to do the data analyses, where and when we need, with accuracy."

—**Paul Currie,**
Vice President and CTO,
HCA Healthcare

Third stacked use case:
Expanding beyond facility walls

While a private 5G network was sufficient for our hospital at the start of its digital transformation, enterprise leadership now looks to expand its reach beyond the walls of its facilities. Driven in part by the COVID-19 pandemic, patients are becoming increasingly comfortable receiving care in their homes or other decentralized locations.[5] Furthermore, shifting care away from the hospital setting can create large cost savings without sacrificing clinical quality for qualified patients.[6]

Even as some areas experience a mix of 4G and 5G coverage while 5G is still being deployed, many 5G devices are "backward compatible," meaning that they can also leverage 4G signals to maintain seamless connectivity if 5G coverage is not yet complete in their location.[7] Additionally, hospitals can leverage priority cellular networks that dedicate capacity to designated health care devices and applications.

Expanding connectivity beyond our hospital's walls will enable applications such as satellite clinics, in which a temporary setup can be quickly deployed for situations such as a "pop-up" clinic in an under-resourced neighborhood or to assist after a natural disaster. It will also facilitate remote patient monitoring, allowing for early discharge from the hospital to home recovery. Remote monitoring and digitally enabled care management can also improve the quality of life for patients with chronic conditions by alerting patients and providers to early signs of decline and delivering real-time "nudges" to encourage healthy behaviors.

Connectivity outside of our hospital also opens up a wealth of opportunity for integration with consumer electronics. As the focus of the health system shifts from "sick care" to ongoing wellness management, consumers are increasingly becoming actively engaged in their own health, with more than 40% of US households owning at least one consumer-centric health device.[8] Data that is already being collected from patients' everyday lives can now be integrated into EMRs and used to augment data collected during formal medical appointments.

"The key goal of the fully connected patient home environment is to re-create the same experience at home, where the patient has more time to read or listen to materials provided by caregivers…for home health, we want to ensure the patient has access to reliable connectivity. We are evaluating the feasibility of creating our own private health network, leveraging 5G/4G cellular or LRAN or whatever we need to ensure network availability to send data back to the care provider."

—Paul Currie,
Vice President and CTO,
HCA Healthcare

Fourth stacked use case:
Next-generation therapeutics

In the final layer of our hospital's stacked use cases, the organization invests in technologies that will enable next-generation patient care. These technologies are implemented last, as they tend to be application-specific and less reusable than previous investments. Additionally, while previous applications benefited from the unique characteristics of 5G, some were feasible leveraging other connectivity modalities (e.g., 4G, LTE, Wi-Fi). In contrast, 5G and/or edge computing are "must-haves" for many next-generation therapeutics, unlocking scientific breakthroughs that were previously bottlenecked by current speed or bandwidth limitations.

As the metaverse comes online and starts to offer health and health-adjacent applications (e.g., simulations for mental health) 5G is well suited to provide the high bandwidth needed for high-definition graphics and the low latency required for a lifelike experience. Applications in this final stack also include connected ingestibles and implantables, which leverage data collected from inside the body for previously unavailable levels of personalization and in-the-moment intervention. Eventually, our hospital can take advantage of remote robotic surgery, enabling expert surgeons from anywhere in the world to operate on patients in different geographies.
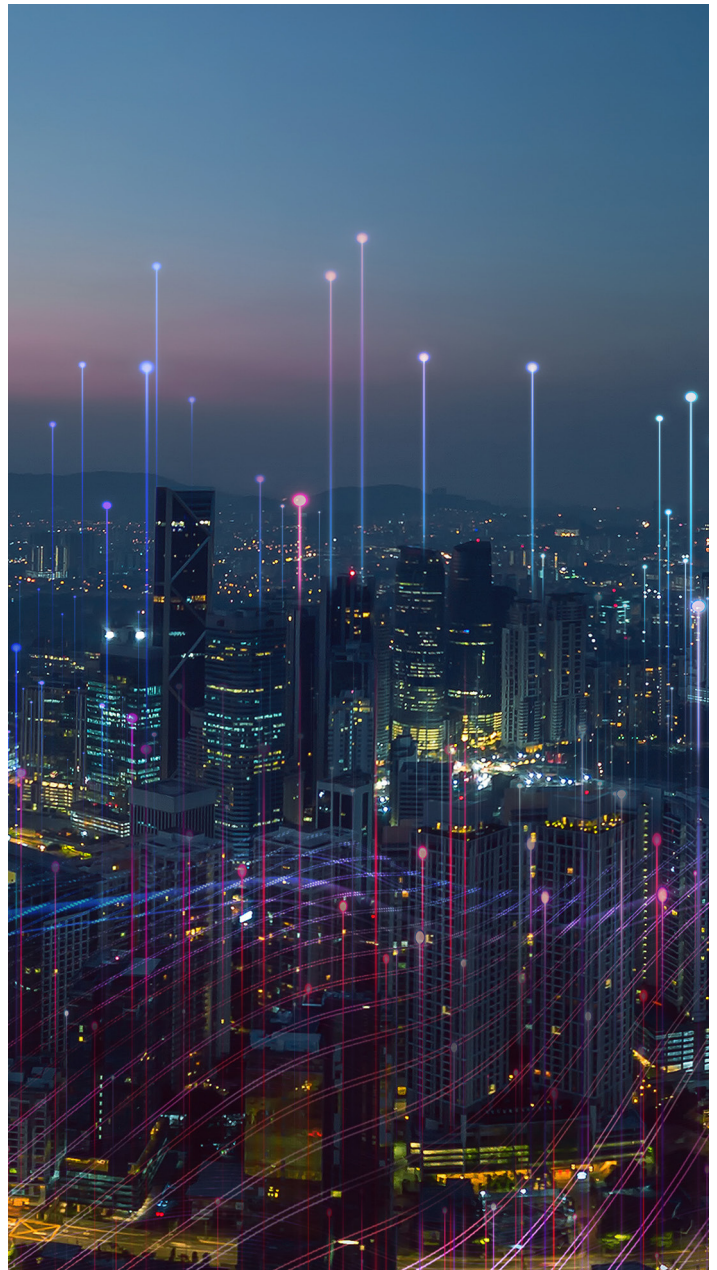
Implementation considerations

Health care leaders should keep the following considerations in mind as they embark on their 5G edge transformation:

Business case

Financial calculations around an initial investment should consider IT infrastructure implications, impacts to other enterprise technologies (such as enablement of more advanced analytics, robotics, or AR/VR applications), and business opportunities created. Some early-adopter health systems are finding success piloting novel applications at a single location, then using this innovation campus as a hub to scale successes to other locations. Deloitte's 5G Ignite tool can help enterprises design and estimate costs (which are often modest for initial build-out of a foundational 5G edge platform) for 5G edge networks and applications. A common challenge of the business case is when it is penalized with the entire cost of the network as organizations seek an unrealistic ROI from the immediate deployment versus the overall benefits of the entire stack.

Data management

5G and edge computing can enable the quick, seamless exchange of information across many data sources. To capitalize on this new capability and to prevent "information overload" for providers and other hospital staff, a robust data strategy becomes even more critical to safeguard data integrity, separate signal from noise, and help ensure that key insights are delivered to the right audiences at the right time.

Security and privacy

As the enterprise collects larger amounts of data, these data stores will likely become increasingly attractive targets for malicious actors. Health care organizations are already feeling these pressures, as reported hacking incidents against health care companies have risen each year since 2015, with a 42% increase from 2019 to 2020.[9] Enhancements in connectivity should be paired with an equivalent focus on cybersecurity to safeguard patient and organizational data.

Regulatory compliance

While there is no US federal or state legislation that directly addresses the use of 5G and edge computing in health care at the time of this publication, governments across the United States have started to address a variety of connected health issues. Organizations should keep a close eye on the dynamic health technology regulatory landscape to understand the impact of new legislation on current and future investment plans.

Organization and change management

An investment in 5G and edge computing will require strong support from leadership. A 5G edge champion should be identified to help to ensure staff understand the value of these innovations and to manage operational changes necessary to fully capitalize on the investment.

Conclusion

As hospitals and health care systems look to what's next on the digital health horizon, a thoughtful 5G and edge computing road map can position the organization to take advantage of transformational opportunities. 5G edge provides flexibility to layer on additional technologies and applications via versatile foundational infrastructure and acts as a key enabler for other emerging technologies. Together, 5G and edge computing can enable organizations to improve patient experience, streamline their internal operations, and deliver next-generation therapeutics in pursuit of a more innovative and healthier future for all.

Sample approaches from two leading health care systems

HCA Healthcare

HCA Healthcare's digital transformation includes a vision for connected care and allowing technology to optimize solutions in a way that enables people to carry out their tasks seamlessly, which helps to enhance care. HCA Healthcare's Chief Technology Officer Paul Currie shared that both 5G and edge play important roles in advancing the existing technology to next-gen solutions, and the health care system has a distinct viewpoint on this topic.

HCA Healthcare emphasizes that its primary objective is to enable people with technology while being purposeful about it. Technology should work for the people who use it by helping to simplify processes to promote the best possible care. For example, the organization is providing physicians and nurses with the right tools to do their jobs, while keeping the technology hands-free to allow for simultaneous hands-on patient care.

"Our goal at HCA Healthcare is to empower people with technology and be purposeful about it."

—**Paul Currie,**
Vice President and CTO,
HCA Healthcare

Providence St. Joseph Health

As Providence St. Joseph Health (PSJH) designs its overall IT road map, it is considering how new technologies will interact with their physical environment (e.g., facilities historically built with less focus on design for computer technology). While the enterprise is evaluating the merits of various connectivity options, the organization's technology leaders are exploring the various infrastructure benefits of 5G and edge computing.

For example, leadership can expect to see a decrease in long-haul WAN costs, reduced footprint for on-prem data storage, and security benefits for IoT applications through investment in 5G edge. PSJH leadership is approaching its Advanced Connectivity journey with a balance of enabling its highest-value use cases and aligning investments within the existing IT road map to match the maturity of other enterprise technologies.

"Edge use cases greatly increase the value proposition of 5G for me. Hospitals were never designed to be data centers, but staff at those facilities need real-time performance that cannot be achieved using a centralized cloud. 5G plus edge offers us something in between that better accomplishes these multiple objectives."

—Kellie Larkin,
Associate Vice President,
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Acknowledgements

Endnotes

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